

LDM Study Status Report & Software/Data Integration Plan

Wooyoung Jang

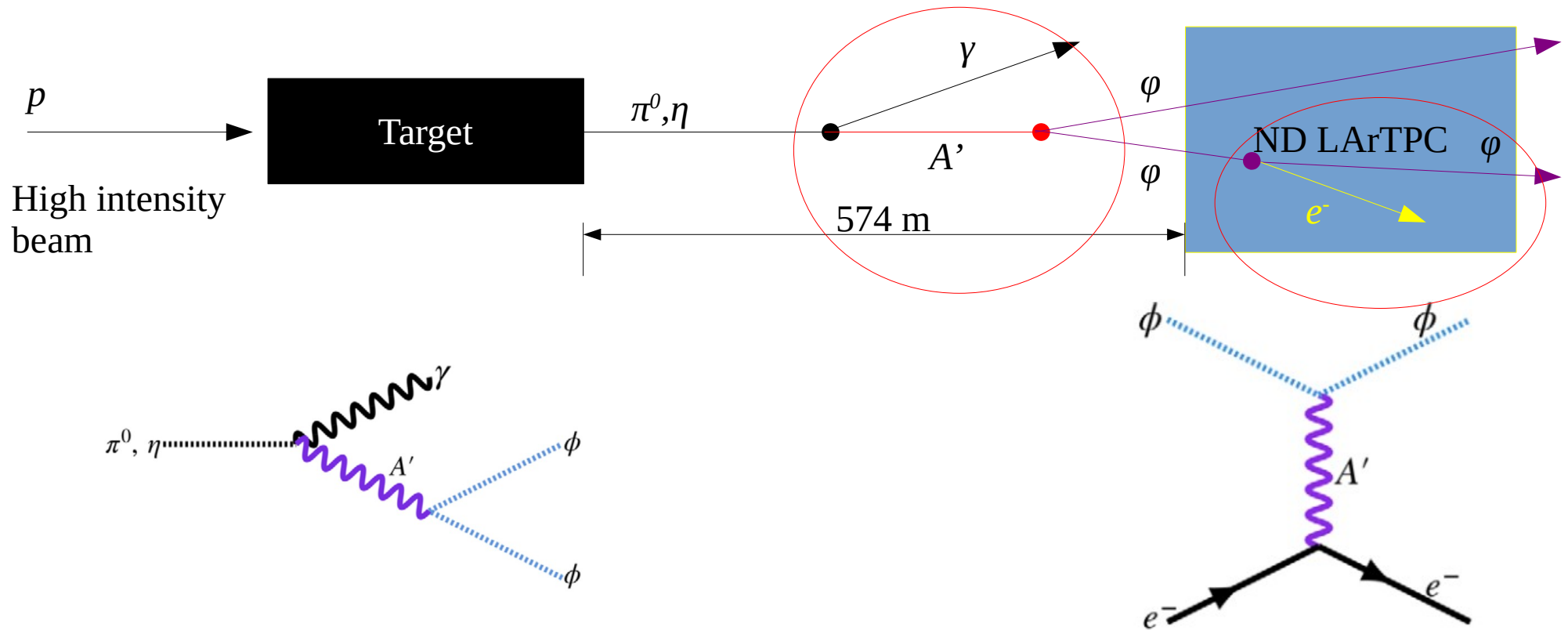
BSM Group Meeting

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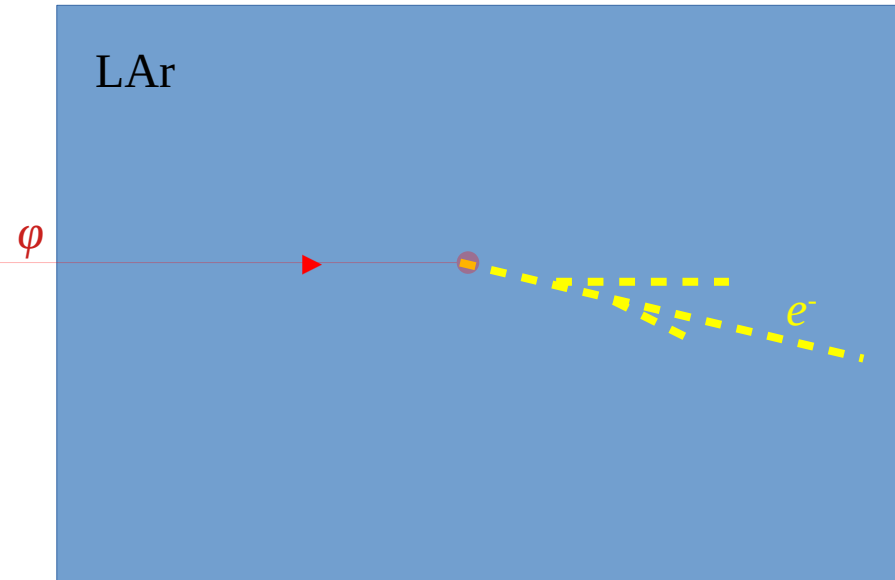
Introduction



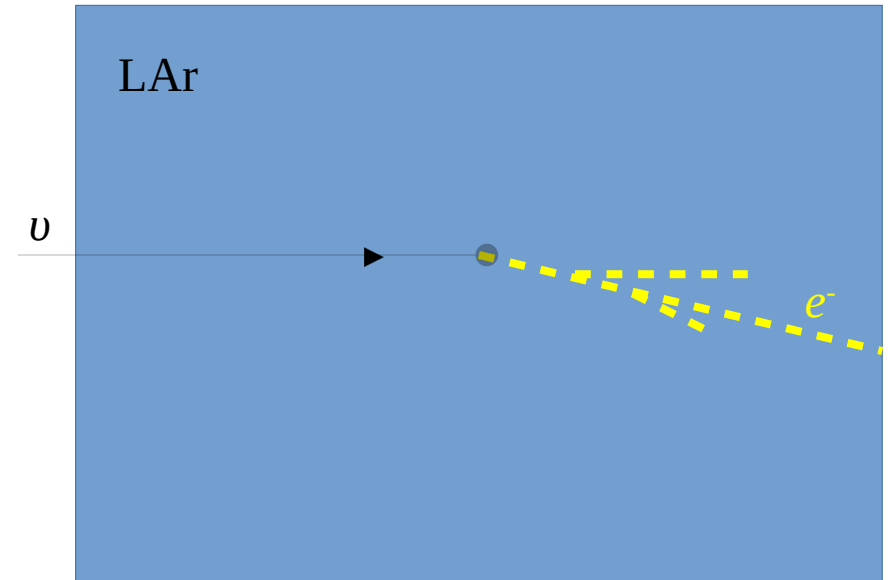
- The Light Dark Matter (LDM) search is a dark matter searching program at DUNE.
- The aim of the program is to searching for a dark matter signature which produced by ‘portal interaction’ mediated by a new gauge boson – so called ‘dark photon’.

Signals & Backgrounds

Dark Matter Signal

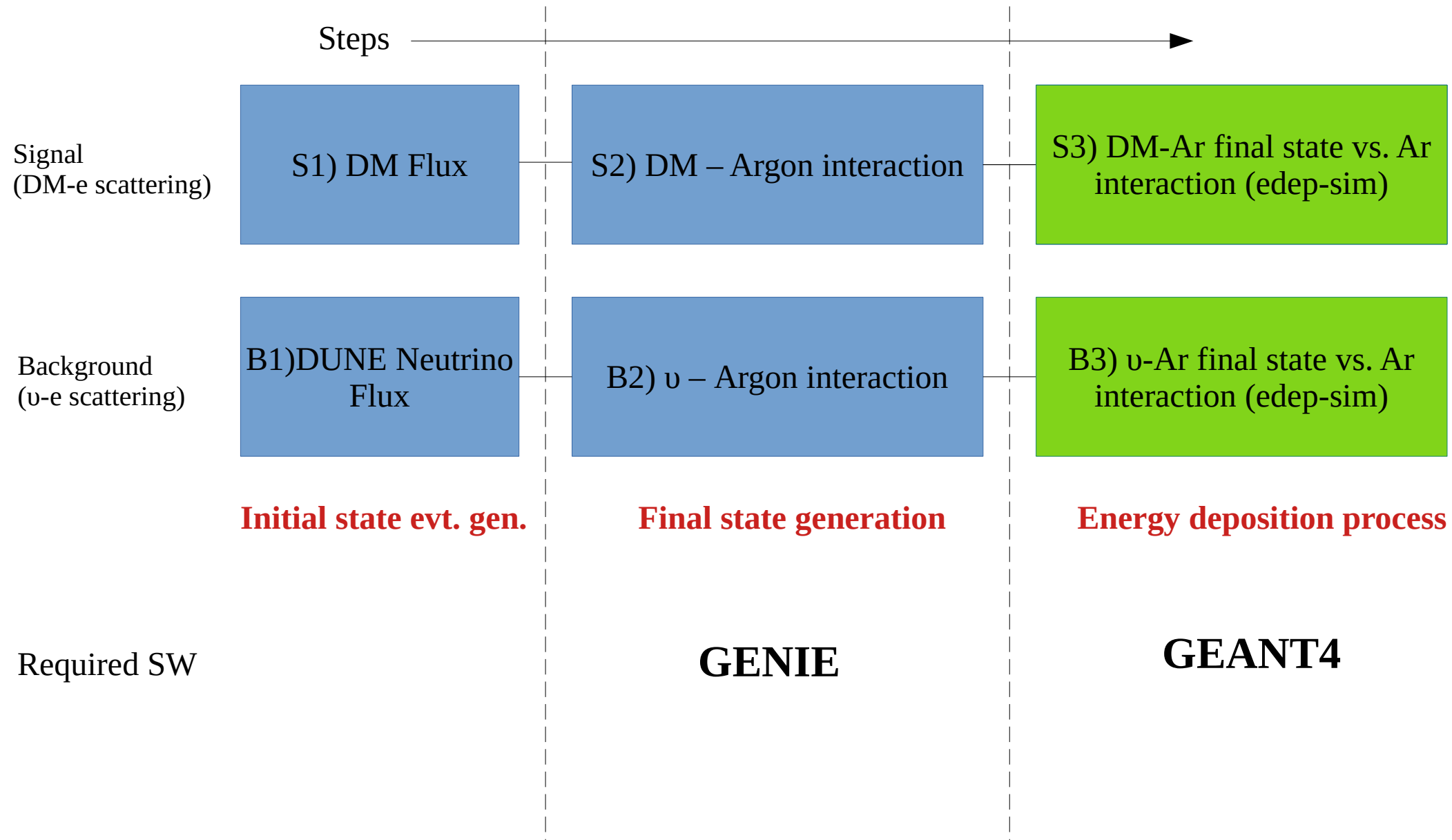


Neutrino Background



- Signal : **scattered electrons** or nuclei in the detector
 - $\varphi + e^- \rightarrow \varphi + e^-$
- Background: **neutral current neutrino interactions**
 - $\nu + e^- \rightarrow \nu + e^-$

Simulation Chain



Current Status

- Currently, we finished the step 2 of the simulation work-flow, the final state simulation using the GENIE MC software.
 - A preliminary run results were presented in the group meeting.
- But, in the mean time, I would like to go back to the DM generation work.
 - **Mono-energetic DM flux** was used in the GENIE simulation so far.
 - Simulate proton-target interaction to obtain **neutral meson energy spectra** using **Geant4**.
 - Calculate their decay kinematics to obtain DM flux using some theoretical assumptions.
- After this, I would like to **validate** the results of GENIE simulations for both signals and backgrounds, and then we'll move forward to the **G4 edep-sim** detector simulation of final state particles.

BSM Software/Data Integration

- Currently, DUNE BSM physics flourishing with a number of attractive research topics such as HNL, Sterile neutrino, KDAR, LDM, Neutrino trident, ALP and possibly more.
- One of the problems observed over the past few months is that our workforce is not being used efficiently in terms of simulation data production and management.
- The ideal goal of this BSM Software/Data Integration work is to establishing a system for an effective production plan, use, and management of these data.
- We agreed to organize a dedicated meeting to discuss these matters and I circulated a recruiting email that looking for volunteers who will serve as a liaisons from each topical group.

ND Data Production Campaign

- Also, there is an update related to the DUNE ND group data production ‘campaign’.
- The ND people are trying to build up a data production plan and this was announced at the ND Software Integration Meeting (Feb. 24) (<https://indico.fnal.gov/event/47379/>)
- Actually, the production request spreadsheet is very systematically designed so I think bench-marking their system will be a good choice for as a matter of consistency.

Data Scheme

- Data Description (Information that can be directly used for characterizing the data sample.)
 - Physics topic code (ex. SLED/HNL/LDM/NSI/ALP/...)
 - Physics specific parameters (ex. $m_{dm} = x$, $m_A = y$)
 - Input flux (FHC/RHC/swapped/cosmic/exotics)
 - Interaction volume geometry (Rock/ND-Lar/ND-Gar/active volume/fid. volume/...)
 - Software (GENIE/Geant4/NuWro/...)
 - On-axis/Off-axis mode
 - Stages (Generator level / G4 detector response level / reco. Level)
- Estimated Resource Requirements (This can be used for storage/computing resource pool estimation)
 - POT #
 - Estimated data size

Example

management_spreadsheet.ods - LibreOffice Calc

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	A	B	C	D	E	F	G	H	I	J	K
1	Data Description									Resource Requirements	
2	Physics Topic and Producer	Flux [Standard, FHC, RHC, swapped, cosmic, other]	Physics-specific Parameters	Generator [GENIE, other]	SW Version	Interaction volumes/Geometry	Off-axis requirement	Final Production Stage [Generator, G4 Det. Response, Reco]	Data Version Identifier (Production Date)	Sample Size [XXX events]	Estimated Data Size
3	LDM (Wooyoung Jang)	other	m dm=?, m A=?	GENIE-BDM	3.0.5 with BDM module	ND-LAr	36 m	Generator	?	1E20 POT	10 GB
4	LDM (Wooyoung Jang)	FHC+RHC		GENIE	3.0.5	ND-LAr	0 m	G4 Det. Response	?	1E20 POT	~ TB
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Summary and Future Plan

- LDM study:
 - Review the DM flux generator first, then move for G4 edep-sim stage.
- BSM Software/Data Integration:
 - Circulate a reminder message to the group.
 - ND production list is adopted for prototyping our data structure.